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Problem-Based Learning in the Middle School: A Research Case Study of the Perceptions of At-Risk Females

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Abstract

The purpose of this study was to examine problem-based learning (pbl) and how students in the middle grades math and science classroom perceived its effectiveness. Analysis of student perceptions of changes in their learning processes and self-efficacy was analyzed through student interviews.

Data identified the components of changes in students' learning processes and self-efficacy, which include self-confidence, group dynamics, and self-motivation. Data revealed that students' perceptions indicated problem-based learning helped them to be more confident in taking control of their learning.

Results indicated that problem-based learning enhances group dynamics and its effects on students at-risk. Noting positive changes in their self-confidence, students believed group involvement enabled them to be more successful in understanding their assignments.

Engaging female students in the math and science middle grades classroom has become more and more challenging. Self and peer acceptance has become their priority, not focusing on being successful on classroom assignments. Finding ways to encourage school participation varies, some successful some not. One method of instruction/learning which has proven to facilitate females' participation in the classroom is problem-based learning.

What is problem-based learning? It is a process of learning where a case problem is presented to students who are asked to apply reasoning, questioning, researching, and critical thinking to find a solution to the problem. It is "focused, experiential learning (minds-on, hands-on) organized around the investigation and resolution of messy, real-world problems" (Torp and Sage, 2002, p. 15). The emphasis of problem-based learning is not on the outcome but on the process, with a focus on students learning to become self-reliant and eventually independent. Working in small groups, students collaborate on the problem, refine and sort their knowledge to find a solution, and then present their solution (or final product) to the whole group with in-depth explanations of their results.

This study provided an opportunity to investigate the perceptions of students involved with problem-based learning (pbl) in middle school math and science classrooms. This study focused on the changes in students' learning processes and the changes in self-efficacy among young women at-risk of failure as perceived by those same students who were the participants in this study.

Students At Risk and Their Issues

Documented studies have stated problem-based learning is successful in both university and K-12 settings while additional investigations have suggested that problem-based learning may be especially productive with students at-risk. The phrase at-risk students conjures many ideas to different people including race, sex, language, and learning capabilities. This study concentrated on female students "at-risk" of failing middle school math or science. The issues that related to this group were identity, classroom environment, and effective instruction.

Among girls, peer relationships move to the forefront during the middle school years. Their self-concept/self-esteem is constantly changing and can be extremely fragile. During this important developmental time, girls often want to display confidence yet remain unsure of the reactions of their peers. How they are perceived by others, particularly by boys, becomes very important.

Studies have determined that emphasizing academic excellence, equity, and student support helps increase female students' self-esteem (Archer, 1993; Backes, 1994). Providing females with activity-based situations and a support system in the math and science classroom has proved most productive. Students reported that they preferred to take ownership, to be involved in planning, and to be allowed to discover rather than be told. The mathematics and science classroom environment poses problems for many female middle school students. A typical science or mathematics classroom is designed for students to master material in traditional settings. Focus on students' self-efficacy or peer relationships is often not addressed. Evidence supports that change in the environment can assist females in succeeding in the middle school science and mathematics classroom. Two important issues for classroom environment for middle school females are self-efficacy and peer relationships.

The interaction of at-risk students with peers and teachers is important to their success in school. Individuals who perceive others as personal resources gain knowledge and skills necessary for life. Studies describe students who believe in their capability to use personal resources as students who have high self-efficacy, particularly in the area of self-regulated learning. The higher their efficacy in mastering the academic subjects, the higher the students perceived their self-regulated efficacy (Bandura, 1993; Zimmerman, Bandura, and Martinez-Pons, 1992; Pintrich and DeGroot, 1990). Findings show self-regulation was the best predictor of academic performance. This suggests that self-regulating strategies are essential for success of academic performance on various types of classroom tasks and that integrating these components into the classroom learning process is critical for future success.

Research indicates at-risk students improve in the science and mathematics classroom when opportunities provide nurturing of peer relationships. Research suggests that collaboration fosters minority student success. "Collaboration within the group is an element of PBL that is necessary to accomplish problem resolution" (Lambros, 2002, p. 3). Aspects of the cooperative group in pbl include "resource identification, peer support, acknowledgement and continued reinforcement of existing knowledge, and assistance and assurance in integrating and synthesizing new information" (Lambros, 2002, p. 3). Problem-based learning helps establish engaging activities in the science and mathematics classroom.

Studies show that cooperative learning groups when compared to traditional learning methods result in greater achievement (Committee on Education and Labor, 1988). Researchers found problem-solving, teamwork, and a caring, nurturing attitude by teachers toward middle school students helped deter them from dropping out of school (Bass, 1991; Bempechat and Wells, 1989). Focusing on collaboration and not competition in the middle school environment enables at-risk students to be more successful in the classroom. Additionally, it is

believed that cooperative learning is an alternative to tracking in the middle school, providing opportunities for all ability levels to work together.

Schunk (1996) stated students differ in self-efficacy for learning, which is affected by their perceptions of learning progress as they engage in the task. Students judge their capabilities for learning prior to receiving instruction. Schunk believed self-efficacy should influence student motivation and self-regulatory efforts during learning. The influence of peer relationships is great in self-efficacy. Schunk reported students are more inclined to believe that if peers can learn, they can learn as well, and that peer modeling is more beneficial than teacher modeling.

In summary, research suggests at-risk students succeed when provided with alternative learning environments. The research literature suggests that cooperative learning methods increase student achievement. Interaction between students in problem-solving situations enhances self-efficacy and self-confidence. Research also indicates a positive correlation between students and their perception of self-regulated efficacy. Beliefs of high self-regulated efficacy positively affect academic performance.

Changes in instruction enhance the ability of students-at-risk to succeed. Types of changes may vary. Cooperative/collaborative learning has proven to be successful with students-at-risk. Problem-based learning focuses on group collaboration.

Methodology

A case study investigation of middle grades students who have been involved with problem-based learning cases was the focus of this research. The use of qualitative data from the use of student interviews was implemented. The questions that guided this study were:

1. How do middle grades math and science students who have been involved with problem-based learning perceive the changes in their learning processes? How do they describe these changes?
2. Have there been any changes in the students' self-efficacy? How do participating students describe these changes?

The case study approach produced a detailed description of participants' perceptions of problem-based learning so that readers will be able to decide how they might use this information. The case study included a bounded system of the collective experience of 14 at-risk females who experience problem-based learning. The participants' shared experiences are the boundaries of this case.

Participants attended various schools in a city school system in the southeast part of the USA. This system's schools vary in student population from 98% minority to 40% minority enrollment. Participants were selected by their teachers. All of the teachers had been trained in problem-based learning from the staff development program at the Center for Educational Research and Teacher Learning (CERTL). CERTL was developed through an Eisenhower Grant. Teachers had been implementing problem-based learning in their classrooms for two to five years.

The teachers were asked to select three students with qualifications that included: female and at-risk of failing the course (science or math) sometime during the year or has had difficulty in the subject in the past. The researcher asked the teachers to choose and implement a problem-based learning case with their classes and follow normal procedures. Class sessions completing the problem-based learning cases were videotaped by a staff member from CERTL. Teachers were interviewed to obtain background information on why they selected these students as participants. They were interviewed individually. Students were also interviewed individually. Interviews were videotaped and recorded for analysis.

Student Descriptions

Nine middle grades classes from three middle schools in the Metropolitan School System provided a pool of

participants for this investigation. There were five eighth grade classes—four science and one math, two seventh grade math classes, and two sixth grade science classes. In the following descriptions of the middle schools, the anonymity of the schools is preserved by using pseudonyms. Two of the eighth grade science classes were from Aloe Middle School which is predominantly minority; the two sixth grade science classes were from Pine Middle School which is approximately a 40/60 percent minority to non-minority ratio, and the remaining classes, two eighth grade science, two seventh grade math, and the one eighth grade math, were from Willow Middle School which also was approximately a 40/60 percent minority to non-minority ratio. The teacher participants in the study selected all classes.

Students involved in the study solved a problem-based learning case during the end of the spring quarter. Fifteen students were invited to participate in separate interviews according to the previously detailed guidelines. Teachers indicated they selected students who liked problem-based learning as well as meeting the criteria stated by the researcher. All students volunteered to be a part of this study. Only 14 students were able to participate in the study. One of the students who was invited was unable to obtain permission. There were five math students and nine science students. Nine of the students were minority, five non-minorities.

The researcher had provided a broad definition of at-risk to the teachers. Teachers, therefore, identified students as at-risk for many reasons. Sarah is classified as a learning disabled student in reading and had displayed difficulty with some written material. Sarah also had not met growth on the Mathematics End-of-Grade test from grade six to grade seven. Lou has been to a neurologist and was placed on medication during the year. Lou had exhibited self-esteem problems at the beginning of the school year. Sue is a slow processor and had displayed difficulty in completing her work. Sue had not met growth on the Mathematics End-of-Grade test from grade six to grade seven. Anne, Kim, and Mary were selected because they began the year with low grades in science. Jane and Sandy were selected due to their displayed difficulty in math. Jane had a low socio-economic background, and Sandy did not perform as well as others in class. Laura and Toni were selected due to their grades dropping during the school year. Laura was also described as displaying an attitude of "I can’t do." Toni also displayed a lack of motivation. Molly dropped three letter grades and was more interested in the social aspect of school.

Three students were selected because they were in danger of failing science. Cathy was in the "athlete mode" and told her teacher “I hate science” on the first day of class. Her grades dropped at the beginning of the year. Linda was always in disciplinary trouble. Her grades dropped at the beginning of the year. Leah was quiet and unmotivated. Her grades also dropped at the beginning of the year.

The researcher met with the students after their problem-based learning case was completed or started. Interview times were prearranged with the teachers. The teachers obtained a place for interviewing. The researcher and the CERTL staff member arrived early to set up the room. Students were introduced to the researcher, proceeded to the interview room, and took their seats. The researcher explained the protocol to follow. The researcher explained the interview would be audiotaped and videotaped. The appropriate machinery was activated and the interview began. The researcher asked the students questions pertaining to problem-based learning, self-efficacy for self-regulated learning, and changes in learning processes.

The design and implementation of problem-based learning cases should all ‘look’ similar in the classroom. Teachers design each case to meet particular areas of content. They present the case in steps called scenarios. Each scenario is written on its own sheet of paper. Scenarios are distributed to students one-by-one. Each scenario adds more detail/clues to the problem. Teachers provide space in a central location for students to focus on what is being recorded. Sheets of poster paper are taped in this location. Students sit in groups. Groups may be designed by teachers or selected by students. A student is selected to be a scribe. Scribes record what others say. They are not to filter or edit these comments. The three sheets of paper are titled: What we know (facts); What we need to know; and Hypotheses. The teacher according to the grade level being taught sometimes rephrases these titles.

Scenario one is distributed and read aloud. Students raise their hands contributing to the 'What we know' and the 'What we need to know' columns. Teachers or scribes may take charge of this step, calling on students one-by-one. All responses are written down. Scenario two is passed out. Students may add or delete items on the two sheets as needed. This process continues through the last scenario. Noise levels during this phase are very low. All students listen to each other. Final product guidelines are distributed before group work starts. Final products may be a report, a letter, or a graphic display.

Students begin work in their groups. They decide what to research and how to research. Some will use written resources. Some will use computer resources. Groups move about freely. Teachers move around answering questions or providing assistance. Noise levels are louder. Students divide research to complete at home. Students return with new information.

Problem-based learning cases vary in length. Day one is whole group participation. Middle days are research days. The last day is presentation day. Students present individually or as groups. Explanations are required. Noise levels during this phase are low. Problem-based learning cases are usually graded by rubrics.

The problems used in this study varied. The sixth grade science class implemented the pbl case "Equinox or Not?" Its focus is on the seasons of the year and the equinoxes. The seventh grade math class used a pbl case named "Abbey Grange". It focuses on the skills/concepts of processes of problem-solving and logical thinking. The eighth grade math class used the case "Patty O'Design" (Appendix A) which involves the use of area, perimeter, and deductive/inductive reasoning. There were two grade eight science classes involved in this study. One used the pbl case "Your Island Factory" which focuses on the concepts of the environmental impacts of industry, chemical reactions, the social perception of pollution, and up-scaling production. The other eighth grade science class used the pbl case "Beachcomber" that focuses on fossils, what they are, the difference between a fossil and a bone, and the types of fossils found in North Carolina. All cases are part of the pbl archived case files at CERTL.

Student Interviews

The researcher interviewed 14 middle grade females who had been taught in the problem-based learning method during the school year. The focus of these interviews was on these students' perceptions of problem-based learning. The researcher designed an interview protocol, which included questions pertaining to the issues addressed in the research literature. The questions (Appendix B) for this interview protocol were adapted from several sources. Questions pertaining to participants' feelings and opinions on their school performance were adapted from Strahan's (1988) study on at-risk adolescents. Questions pertaining to participants' self-regulated learning were designed and adapted from Zimmerman, Bandura, & Martinez-Pons' (1992) topics for self-regulated learning, and Bandura's (1994) Self-efficacy for Self-regulated Learning features. Additional questions were designed by the researcher to solicit students' perceptions of their recent pbl experience. There were a total of 18 questions for the interview. Student interviews were conducted within one day to three weeks of completion of the problem-based learning case.

Analysis Procedures

Content analysis, as described by Worthen and Sanders (1987), provided a framework for analyzing data. They described content analysis as a process seeking "to quantify content objectively, according to explicitly formulated rules and mutually exclusive and exhaustive categories" (p. 314). This process allows the searching for evidence of recurring patterns and themes throughout the data.

In this study, the process of content analysis began with an examination of the interviews. Transcribed interviews were analyzed for content to denote any patterns. The student interviews provided data to profile their perceptions and descriptions of changes in their participation in the classroom.

The researcher identified the main topic in each research question then read the transcripts highlighting the pertinent information on the respective subjects. Alternate colors were used for each question, and then tran-

script data was sorted into its individual files according to its relevancy. An example would be the placement of all students' responses pertaining to self-efficacy in one file for ease of previewing. Student interview data was sorted into five files. Each file was read multiple times throughout the reporting process of this study.

The researcher is an experienced middle grades math teacher who was trained in problem-based learning and had used pbl in her classroom for more than two years. She had also been part of a case-writing team for her school. The researcher has a strong commitment to the use of problem-based learning. However, this research was not a self-study. The researcher was not a participant in this study; she acted as an observer only.

In summary, this research, through careful examination of qualitative data, examined the perceptions of students' learning processes and their self-efficacy. This in-depth analysis allowed the researcher to gather information from students' structured interviews. The research framework included data-gathering techniques that can be replicated in other settings to study middle school students-at-risk and their learning processes and self-efficacy.

The limitations of this case study included the demographics of the small number of students, 36% were white, and 64% were African-American. Another limitation was the fact that this group was selected from a finite group of teachers who were willing to volunteer in the study. A third limitation was that teachers might have chosen students they believed would respond more positively to problem-based learning. Consequently, the study may not relate to other at-risk students in other middle schools. These limitations decreased the generalizability of the study. In reporting this case study, the researcher attempted to offer sufficient detail to permit the reader to assess the extent to which results may offer insight into other situations.

Results

Students expressed their beliefs that problem-based learning cases help the learning environment. Students were overwhelmingly positive in their responses pertaining to liking problem-based learning. All of the 14 participants responded yes to the interview question of whether or not they liked problem-based learning. Some of their reasons included how the problems interested them, being able to work in groups, and the challenge of the case. The challenge of the case(s) sparked the interest of some of the participants where enjoying problem-based learning meant that they were being challenged to think differently, to be open to new ideas and not be judgmental, and to be supportive of each other.

Toni, the sixth grader, claimed, "It's fun to do it and you're like, using your brain." Katie and Anne, classmates in the same science class focused on the chance to give their ideas. "We just come up with all these ideas. It's given us a chance to say [those ideas]" (Anne). Katie prefers the variation of the process. "I like the research, ... you do different things, show your pictures [final product], ... give the ideas." Sandy, an eighth grade math student, likes how problem-based learning is non-threatening. "[There's] not really a right or wrong answer." Finally, Linda, an eighth grade science student, explains the challenge from her perspective; "It keeps me on my feet. I have to turn it in at a certain time and I work better if I'm pressured. I have to find stuff for other people, which I like doing. I like it."

Interview responses describing how problem-based learning had assisted them included being better organized, paying better attention, keeping on task, learning from others, processing information, and how to use it in real-life situations. Participants responded that they noticed how pbl had helped them change their learning processes, and enabled them to complete more assignments in all their classes.

Sarah, a seventh grader, stated, "It's helped me with [organization], like organization is one of the major things cause I have to be able to organize all the stuff, learn how to do them. And I like working towards stuff ... at night it's got me doing that ... doing my work good."

Toni, a sixth grader stated, "Well, in pbl, it's helped me to pay attention, you know stay alert ... and that helps me to like pay attention in all my other classes, ... because you never know, you might get a question like that

in another class." Linda, grade eight, adds that the problem-based learning process keeps her on task, "It just helps me, makes me faster, and makes me [more] able to do [my assignments]."

Participants also indicated that working in groups was of a great benefit to their learning process and assisted them in developing a respect for others and listening to what they have to say. Most stated they became better group participants through the pbl process. They also stated how pbl enabled them to better utilize all the resources available for them (media center, Internet, printed materials). Cathy (grade eight) and Molly (grade six) both felt the opportunity to work with others affected their performance in school. "You can get closer to people, people that you don't know, you might get to work in a group with them, be able to get along with more people ... It helps a lot with your school work and how to work with people" (Cathy). Molly stated, "I do better with pbl, because since it is a group activity, you get more than just your opinion, so it's a wide range of opinions."

Additionally, participants specified that the process of problem-based learning itself was a benefit to their learning. Statements included the listing of strategies and outcomes helped them change in their learning processes. Lou (seventh grade) commented, "It shows me how to do that and ... it's a new way of learning ... it's like uh, it's a little hard to explain, but it, like, helps you out [with] other things, not just one thing, but it can help you out with a lot of other things in life."

Real-life problems were the focus of Jane (grade eight) and Leah (grade eight). Jane commented, "It helps me think about how I can put that (pbl) use into real life." Leah enthusiastically stated how much she felt problem-based learning has affected her overall performance. When she answered the question, has pbl affected her overall performance in school, she stated, "I would say, yes, it has, it has, it's really fun". Her description of how she felt it to be so focused on opinions and real-life situations. "We have times we get to … [state] … our opinions on different stuff in the world, to get a chance to do work, working with things that happen and occur in the world."

Self-Efficacy and Problem-Based Learning

Self-efficacy has a strong correlation to problem-based learning, particularly in the domain of self-regulated learning. As discussed in the research literature, self-regulated learning includes the areas of motivation, self-confidence, obtaining information, concentration, working within deadlines, and inquiring information from peers and teachers when needed. The researcher explored these relationships with the participants in this study. Students were questioned about their perceptions of the changes in their self-motivation and self-confidence as affected by problem-based learning.

The researcher collected data from each student participant describing what they believe motivates them to complete their schoolwork. Students named several factors. These factors included self, parents, teachers, peers, and wanting to go to college. Several students selected more than one motivator as a determining factor. Self was selected as the main source of motivation in nine of the cases. Five students named parents. Mentioned twice were peers, teachers, and wanting to go to college.

Data collected for self-efficacy for self-regulated learning focused on four areas related to problem-based learning. They are use of the library, concentration in school, homework deadlines, and ability to be outspoken/participate in class discussions.

Participants were asked whether they believed pbl enabled them to use the library more often—nine students answered yes and two said no. Two students indicated sometimes or not really. No data was available for one case.

Jane provided elaboration on why problem-based learning has benefited the students. "Because you have to look up information in order to find some stuff about it because not everything in the problem that they give you is [there]." Laura added, "I think it has enabled me more to go…[to the library]… cause then I have more

information to give, and I can find more solutions to problems." Linda summarized with an example, "We have to look up all sorts of stuff like, how much would I weigh on the moon. Like we had one with a moon ball so we had to figure out how much the ball needed to weigh to bounce and a whole lot of [other] stuff."

Thirteen students answered the question on the effectiveness of pbl and their concentration in school with a yes. One answered not really. Katie was unclear in her explanation of why she indicated not really. She commented, "Well, cause some of the stuff there wouldn't be..." then she stopped with "I don't know." (The researcher noted that Katie didn't fully answer all the questions. She seemed uneasy when she wasn't sure of an answer.)

Students' interesting comments on the effectiveness of problem-based learning and their concentration were many. Linda stated, "Um... like, if I'm in a different class and the teacher gives me a problem and she says I have to figure it out by the end of [the] period, then I'm able to do it cause it's like, I know where to go to look for stuff and it just automatically comes." Cathy claimed, "It is helpful, I mean it... pbl, it's fun and you get to work with people and it shows you how to work with different people,... and... [you can] express your feelings instead of holding things back,... and you get to say your opinions, so it's easier." Toni maintained, "Well, you have to listen to your facts, and so it helps you be alert and pay attention to what's going on." Lou remarked, "Um. I think it sort of teaches you to figure things out, you know, without just having to look straight at the answer, you know, take a few things from the background and you know, just figure it out." Laura summarized, "It's made me more like, effective to the problem, cause I can really relate to it now, cause we have good pbl problems, like fun pbl problems, I just like those. It makes me concentrate more."

Ten students declared yes on having always completed homework assignments on time. Two answered no. Two said most of the time or sometimes. Mary said, "At the beginning of the year, no [I did not complete homework assignments on time], but since I was trying to improve my grades, yes, I have [started to do so]. Linda stated, "Eighth grade, I had my big turn [in completing homework]... cause I was going to high school next year." The one student, Molly, who said most of the time, did not clarify her answer.

Students contended homework was an important part of their grade. The relationship between homework and success in school recurred in several interviews. Anne expressed, "I believe it's really important to finish our homework on time, because the homework is given to us to do at home and in order to do homework it will help us like prepare for the [assignments] in class that are part of the curriculum." Sandy stated, "Because it helps you build, being able to do things on time and it really prepares you for the real life." Laura adds, "Well, you get a grade on it, of course, and it helps you learn out of school as well as in school,... a lot of people are saying 'We shouldn't have homework and stuff' and I think we should because it helps us study more and learn more than we do in school."

Seven students declared yes on being an outspoken person. Five indicated no, two said sometimes. Comparing these responses with the second portion of the question, 13 indicated they participate in class discussions. One indicated sometimes. Sarah (response of no/yes) stated, "I like to keep quiet. [But I participate in discussions] because I like talking to the class but I don't like, I'm not, ... " (The researcher noted Sarah being very shy during the interview, showing reluctance at times to answer.) Katie (response no/sometimes) explained she isn't outspoken and only sometimes participates in class discussions. "Some of it doesn't interest me but ... " (The researcher noted again her uneasiness.) The two sometimes/yes responses were explained. Sandy remarked "You understand the problems and you ask questions and you get involved in it, and it's a lot funner and you understand it better." Laura explained, "I just have a lot of things, like, to say, and I have, like when we're doing pbl I really have a lot of solutions."

Data conveyed the importance of group dynamics and the importance of role-playing, hands-on/participatory activities. Students who don't speak out to the whole group will do so in the small group. Students tend to feel more comfortable in group settings as the year progresses and will change roles within the group. PBL provides opportunities for this experience. Each case contains various activities/roles allowing students to participate in different capacities throughout the year.

Summary

The purpose of this study was to examine problem-based learning and how students in the middle grades math and science classes perceive its effectiveness. This study identified key components related to the success of problem-based learning and females at-risk. This study examined these components in relation to middle level students' perceptions of changes in their learning processes and self-efficacy. The researcher used structured interviews to understand the perceived changes in students' learning processes and self-efficacy.

Specifically, the researcher examined the relationship between problem-based learning and students' changes in performance in the science and mathematics classroom. This examination of information gained from these interviews provided insight into the perceived relationships. Students articulated their perceptions of changes in their classroom behavior and problem-based learning. This provided an understanding of the effectiveness of problem-based learning on female students at-risk.

The fact that students perceived changes in their performance was a positive finding. Students' perceptions tended to be similar in describing the changes in their learning processes. Students tended to describe their ability to sort, list, and solve problems more effectively using problem-based learning.

Results from this research indicated that students recognized their need to socialize while learning. Students' successful collaboration to produce a solution was evident. Students' perceptions of their success in this setting were overwhelming.

Results from this study suggested problem-based learning increased the students' self-efficacy. Results indicated students perceived increases in their involvement in class when doing problem-based learning. Group participation to share ideas and opinions was a positive factor for student involvement. Paying attention and solving the cases was strongly supported in this study. Students indicated that knowing the problem-based learning process provided them with a tool to use in all classes.

Additionally, results indicated that students tended to perceive their involvement in problem-based learning cases as the cause for increases in their confidence. Students indicated cases were challenging and fun, presenting them with authentic problems to solve. Also, organization and keeping on task was mentioned as a factor for increasing confidence. Students indicated they perceived that problem-based learning affected their overall performance.

Results from this study indicated that students perceived that problem-based learning encouraged their interest and provided a more in-depth understanding of the concepts. Students' perceptions indicated that problem-based learning helped them learn more about a topic and created a feeling of excitement about coming to class. Also, students tended to perceive problem-based learning as a catalyst for their motivation and overall success.

Results from this study indicated that, with few exceptions, students had a strong belief in the problem-based learning process and its success with students at-risk. This was indicated by the examples they offered throughout the study. Most students were articulate in their examples of how they have observed problem-based learning and its implementation. The belief that problem-based learning is "a new way of learning . . . [that] it helps you out [with] other things . . . a lot of other things in life" (Lou), was emphasized throughout the study.

Qualitative results indicated high levels of perceived success with problem-based learning. On all the identified components of changes in students learning processes and self-efficacy—self-confidence, group dynamics, self-motivation, and independence—all students indicated problem-based learning had positive reactions. Results indicated all students benefited from problem-based learning in one way or another.

Conclusions

Results of this study found students stated that problem-based learning assists them in performing learning tasks more successfully. Students explained the value of using real-world situations in the problem-based learning cases to be beneficial in increasing their interest. Students reported improvements in their ability to use resources, complete assignments on time, and to be involved in the problem-based learning process. Data indicated high self-efficacy for self-regulated learning.

Implications

Overall, this study indicated that problem-based learning can be a successful method of learning for students-at-risk of failing. Students reported enjoying the process and stated they were more motivated to be involved. While one student expressed some lack of involvement, the other 13 reported higher levels of engagement with problem-based learning tasks.

The results of this study indicated that problem-based learning enhances group dynamics and its effects on students-at-risk. Students believed group involvement enabled them to be more successful in understanding their assignments. Students noted changes in their self-confidence. They expressed satisfaction with their participation in problem-based learning, stating they felt involved and that their opinion mattered.

Overall, this study suggested strong potential for problem-based learning, offering students useful tools for learning throughout life. Students remarked they believed problem-based learning helped them increase their concentration in school. This positive reaction to problem-based learning may facilitate increases of students-at-risk being successful in the math and science classroom.

References

Archer, E. (1993). *The urban schools science and mathematics program*. Academy for Educational Development, Inc., New York, NY. (ERIC Document Reproduction Service No. ED 359290)

Backes, J. S. (1994). Bridging the gender gap: Self-concept in the middle grades. *Schools in the Middle, 3*(3), 19-23.

Bandura, A. (1993). Perceived self-efficacy in cognitive development and functioning. *Educational Psychologist, 28*(2), 117-148.

Bass, A. (1991). *Promising strategies for at-risk youth*. (Report No. ERIC Digest No. 59.) Eugene, Oregon: University of Oregon. (ERIC Document Reproduction Service No. ED 328958)

Bempechat, J., & Wells, A. S. (1989). *Trends and issues in urban and minority education, 1989: Promoting the achievement of at-risk students*. (Trends and Issues No. 13). New York, NY: Teachers College, Columbia University. (ERIC Document Reproduction Service No. ED 315484).

Committee on Education and Labor, U.S. House of Representatives, One Hundredth Congress. (1988). *Educational policies and practices: Their impact on education, on at-risk students, and on minority teachers*. (ERIC Document Reproduction Service No. ED 296042)

Lambros, A. (2002). *Problem-based learning in K-8 classrooms: A teachers' guide to implementation*. Thousand Oaks, CA: Corwin Press.

Pintrich, P. R., & De Groot, E. V. (1990). Motivational and self-regulated learning components of classroom academic performance. *Journal of Educational Psychology, 82*(1), 33-40.

Schunk, D. H. (1996). *Self-efficacy for learning and performance*. Paper presented at the Annual Conference of the American Education Research Association, New York, NY.

Strahan, D. (1988). Life on the margins: How academically at-risk early adolescents view themselves and school. *Journal of Early Adolescence, 8*(4), 373-390.

Torp, L., & Sage, S. (2002). *Problems as possibilities: Problem-based learning for K-16 education*. 2nd edition. Alexandria, VA: ASCD.

Worthen, B., & Sanders, J. (1987). *Educational evaluation: Alternative approaches and practical guidelines*. White Plains, NY: Longman.

Zimmerman, B. J., Bandura, A., & Martinez-Pons, M. (1992). Self-motivation for academic attainment: The role of self-efficacy beliefs and personal goal-setting. *American Education Research Journal, 29*, 663-676.

Appendix A

Patty O' Design*
A Problem-Based Learning Case

Scenario 1

You are employed as a landscape architect. You work on the design team and your group receives this letter:

> Smith-Jones Landscaping Design, Inc.
> 1575 East Forsyth Boulevard
>
> Dear Sir or Madam:
>
> We are interested in adding a patio to our house. We have decided that we would like to use as much as possible of the 20-foot by 20-foot area directly behind our house for a patio shaped in a nontraditional design. We would like for you to submit two designs with specifications so that we can choose the one we like better. Please be aware that we want to use at least 340 square feet of the available area for the patio.
>
> We have read your brochure and enclosed the $200 design fee. We appreciate your guaranteed delivery date of one week.
>
> Sincerely,
>
> Ian and Patty O'Brien

What would be helpful to know before you begin your design? How will this information help you? What will you do next?

Patty O' Design*
A Problem-Based Learning Case

Scenario 2

Smith-Jones Landscaping Design, Inc.
1575 East Forsyth Boulevard

Dear Sir or Madam:

This letter is to inform you of the modifications we would like to add to our original instructions in regard to your company's designing a patio for us.

Looking back on our vacation photos of our trip out west last year, we were reminded of some creative yet beautiful patios we saw. We would like for you to make sure that your designs for our patio have the following features:

- We would like two areas for flowers on the sides of the patio that are adjacent to the house. Please use only about 70% of patio footage for the flower areas; then on each side extending from the house out to the yard, use about 80%.
- A small area in the center of the patio for flowers (this area should be in the same geometric shape as the patio design and about 10% of the entire patio size).

Again, thank you very much for your cooperation and understanding in this matter. We eagerly await your designs.

Sincerely yours,
Ian and Patty O'Brien

*Sample case from Ann Lambros' *Problem-based learning in K-8 classrooms: A teachers' guide to implementation*. Corwin Press, Inc. 2002.

Appendix B

Interview Questions for Students

1. What are some things you do well in school?
   Why do you think you do _____ so well?
2. What are some things you don't do so well?
   Why do you think you don't _____ so well?
   If you tried to _____ really hard and did your very best, how do you think you would do?
3. Do you like science?
   (if “yes”) What is it about science that you like so much?
   (if “no”) What is it about science that you dislike so much?
4. Do you like math?
   (if “yes”) What is it about math that you like so much?
   (if “no”) What is it about math that you dislike so much?
5. Do you like problem-based learning cases?
   (if “yes”) What do you like about pbl case problems?
   (if “no”) What don't you like about pbl case problems?

6. *Do you use the library to get information for your class assignments?
   (if "yes") How well can you use the library to get information for class assignments?
   Has pbl enabled you to use the library more often?
   (if "no") Why don't you use it more often?
7. *Do you feel pbl has affected how well you concentrate in school?
   (if "yes") Describe how you believe it to be so.
   (if "no") Describe how you believe it not to have been helpful.
8. *Tell me how well you can finish homework assignments by deadlines.
   Have you always completed assignments on time?
   (if "yes") Why do you think this is important?
   (if "no") Can you pinpoint when you began finishing homework assignments on time?
9. *Do you consider yourself an outspoken person; one who participates in class discussions?
   (if "yes") Tell me what you do to make you believe that.
   (if "no") Tell me why you don't feel comfortable participating in class discussions.
10. *Tell me how well you can motivate yourself to do school work.
    What is it that you believe pushes you toward this goal?
11. Do you feel pbl has affected your overall performance in school?
    (if "yes") Describe how you believe it to be so.
    (if "no") Describe how you believe it not to have been helpful.
12. You've recently had a video-tape made of your class doing a pbl problem, tell me about the case.
13. What concepts do you think the teacher wanted you to learn in that case?
14. Tell me about _____.
15. Tell me how you worked through the problem.
    List the steps you followed.
    Describe how you felt during this process.
16. If your teacher asked you to work on another case next week. How would you go about solving the case?
    List the steps you would follow.
17. Where would you use pbl in the future?
18. What do you hope to be doing when you are 20 years old?
    Why is that important to you?
    How does school fit into your plans?
    What do you think you will have to do to get to _____?

* adapted from Zimmerman, Bandura, and Martinez-Pons' (1992) topics for self-efficacy for self-regulated learning and Bandura's Self-efficacy for Self-regulated Learning (1993).

Questions adapted from Zimmerman, Bandura, and Martinez-Pons' (1992) topics for self-efficacy for self-regulated learning, Bandura's Self-efficacy for Self-regulated Learning (1993) and Strahan's Guidelines for structured interviews (1988).